

## PHD POSITION AT CNRM (TOULOUSE)

### IMPACT OF HETEROGENEITIES ON FOG MODELLING DURING THE LANFEX CAMPAIGN

**Laboratory** : French Meteorological Research Center, research unit of National Center for Scientific Research (CNRS) and METEO-FRANCE. Toulouse. FRANCE (<http://www.cnrm.meteo.fr>)

**Research group** : Meso-scale meteorological group (GMME )

**Start date** : October 1<sup>st</sup> 2016

**Duration** : 3 years

**Deadline for application** : March 31<sup>st</sup> 2016

**Gross salary** (before taxes): 1757 € / month.

**Supervisors** : Dr Christine Lac, Dr Thierry Bergot (HDR), Dr Benoît Vié

#### Context :

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Fog is a high impact weather type on personal safety and economy, which remains extremely difficult to forecast accurately, despite recent advances in numerical weather prediction. Although the basic requirements for fog formation (high relative humidity, low wind speed and clear night skies) are well known, the more complex local and non-local processes which influence the timing and location of fog formation are not well understood.

In order to better understand these processes, and to improve the fog-forecasting ability, a large observational campaign (LANFEX) is currently being undertaken at two locations in the UK over two winters. The campaign comprises 13 sites at a variety of hilltop and valley sites in Shropshire, as well as five companion sites in the much flatter Bedfordshire area in eastern England. Six main sites are equipped with instrumentation including flux towers, nephelometers, aerosol spectrometers and dewmeters. 15 sites are also equipped with spectrometers measuring the fog droplet size distributions and liquid water content. The first Intensive Observation Periods of winter 2014-2015 have shown a strong variability in the occurrence and characteristics of fog between the different sites. So the central question is : how can the same mesoscale air mass evolve differently in close locations with different orography ?

#### PhD description:

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The objective of the PhD is to study one or more fog cases observed during LANFEX with Large Eddy Simulations (LES), run with the Meso-NH model (<http://mesonh.aero.obs-mip.fr/mesonh51>), in order to better characterize the impact of orography on the fog life

cycle. Different LES have already been performed with Meso-NH over flat terrain, in order to characterize turbulent structures during the fog life cycle (Bergot, 2013) or the impact of small-scale surface heterogeneities like buildings (Bergot et al., 2015). The objective is to conduct the same type of study with a focus on surface heterogeneities due to orography.

It is also of primary importance to represent correctly the microphysical processes driving the fog life cycle, and their interaction with dynamics and radiation. For this purpose, the 2-moment mixed-phase microphysical scheme of Meso-NH, called LIMA (Liquid Ice Multiple Aerosols, Vié et al., 2015), that predicts droplets, drops and crystals concentrations in addition to the mass of hydrometeor species, will be used. The originality of LIMA is to include a detailed prognostic representation of aerosols, in terms of chemical composition and size distribution, to serve as Cloud Condensation Nuclei and/or Ice Freezing Nuclei, depending on their solubility. The coupling between LIMA and the radiative transfer code takes into account the droplet concentration and aerosol radiative properties : this is important to predict fog top radiative cooling, optical thickness and visibility. It will therefore be possible to characterize the impact of orography on aerosol distribution and the microphysical variability of fog, like for instance accumulation of aerosols into valley floor leading to variability in the radiative properties of the fog. Simulations will be validated and analyzed with all the observations available with LANFEX.

### **Qualifications :**

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- Master of science degree or Engineer degree
- Knowledge in turbulence
- Knowledge in microphysics
- Experience in atmospheric modelling
- Ability to program in Fortran
- Ability to write scientific papers in English
- Teamwork ability

### **References :**

*Bergot, T., Small-scale structure of radiation fog: a large-eddy simulation study, Quart. J. Roy. Meteor. Soc., 139, 1099-112, 2013.*

*Bergot, T., J. Escobar, and V. Masson, Effect of small scale surface heterogeneities and buildings on radiation fog : Large-Eddy Simulation study at Paris-Charles de Gaulle airport, Quart. J. Roy. Meteor. Soc., 141, 285-298, 2015.*

*Vié, B., Pinty, J.-P., Berthet, S., and Leriche, M.: LIMA (v1.0): a two-moment microphysical scheme driven by a multimodal population of cloud condensation and ice freezing nuclei, Geosci. Model Dev. Discuss., 8, 7767-7820, doi:10.5194/gmdd-8-7767-2015, 2015.*

**Send applications (covering letter and C.V.) to: [christine.lac@meteo.fr](mailto:christine.lac@meteo.fr)**